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ORNITHOLOGICAL REPORT FOR NORFOLK (1913).

By J. H. Gurney, F.Z.S.

(Assisted by Members of the Norwich Naturalists' Society.)

(Plate II.)

As usual I take up, with the Editor's permission, the duties which fall to an ornithological coroner, and in doing so feel it to be a matter for satisfaction that these annual "Norfolk Notes" are now, for the most part, the records of birds identified, not killed. Gamekeepers, however, still continue to shoot many creatures, both winged and furred, which they had better let alone. It happened to the present writer last year (July 18th) to inspect a gamekeeper's "larder-tree," on which were suspended the following delinquents (besides many Hedgehogs, Squirrels, Stoats, Weasels, and Cats): twenty-six Jays, two Hooded Crows, one Spotted Woodpecker, six beautiful Kestrels, and three Tawny Owls; afterwards increased to eight Owls, as I was informed, in spite of the law, which is a dead letter. During the summer an adult Hobby was sacrificed to a keeper's ignorance, just at the time when it should have been going to nest (May 21st), and this happens every year. Forty-seven years ago Henry Stevenson could write of the Hobby as a very regular summer migrant, but Plate II. shows what happens to Hawks in Norfolk nowadays. I am afraid a good many Kestrels and Brown Owls were also killed.

The Spring Migration.—The spring of 1913 was chiefly noticeable for a lamentable deficiency among our garden favourites—Willow-Warblers, Whitethroats, Nightingales, Redstarts, Garden-

Warblers, and Blackcaps, which were almost as few in number as in 1912. Can it be that they are drowned in crossing sea when on migration, or is it more probable that they perish in the destructive "roccoli,"* which find such favour in Italy?

The usual migration of Rooks and Crows passed Cromer, flying E.S.E., a direction which, if maintained, would bring them to land near The Hague. Fieldfares also and Redwings were seen leaving, but no Buzzards. There was a marked coastal movement of Wagtails.

The first Spoonbills were a fine pair seen on Breydon Broad by Mr. B. B. Riviere on May 1st; wind S.E. to S.W., force 2. Many other birds were on the mud-flats, including five Sheld-Ducks, Wigeon, Shovellers, and a White-fronted Goose (G. Jary), all of them travellers going north or east. From that date until August 16th there were twenty-six days out of one hundred and six on which the watcher was able to register the presence of Spoonbills. According to his carefully kept notes, the longest period during which there was not a Spoonbill on the Broad was from May 29th to June 11th. On June 25th Mr. C. R. Gurney and I had a distinct view of three, and on July 6th there were four, this being the largest number seen by the watcher on any one day. In recording the visits of Spoonbills Mr. Jary has always been requested to carefully observe the direction of the wind. Accordingly, in looking back at his notes for many years, we learn that forty-four Spoonbills have come to Breydon Broad with a N.E. wind, and seven with a N.W.; twenty more have come with a W. wind, eight with a S.W., and six with a S. wind. These observations were all made in April, May, or June, and a good deal may be gathered from them. Evidently in the spring it is a N.E. wind which generally brings Spoonbills; but this is curious, because in April and May their desire on leaving southern Europe would be to migrate north, or perhaps north-west. Do they then prefer to migrate with a wind which is against them? There is, however, another solution, namely, that it is a N.E. wind whereby they are checked, and without which many would pass on without halting on the Breydon mud-flats. This latter theory seems highly probable, and it certainly appears that when the wind has been S., a few only (fourteen in about as many years) have stopped on Breydon Broad, the rest presumably wending their way to a breeding-place in Holland.

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* These "roccoli," or devices for catching birds, especially Thrushes, are numerous throughout the north of Italy; they consist of small groves of low trees, trimmed and trained for the most advantageous disposal of thin one-inch mesh nets, while inside these seductive arbours is heard the piping of different sorts of decoy-birds. The nets are kept going during the migratory season, and everything down to a Long-tailed Titmouse is killed if captured by the peasants. There is, however, no reason for supposing the death of more victims in 1912 and 1913 than usual.

Mr. F. C. Jourdain is of opinion that the largest Spoonbill settlement in Europe is probably that at Obedszka-Bara, in the Gegenwart (see Jakob Schenk, 'Aquila,' 1908, p. 245), but it is not likely that our Breydon birds nest there, or even pass it on passage.

The Breeding Season.—All Norfolk gamekeepers agree that the 1913 hatch of Partridges was excellent, the weather being dry and yet not too hot, but in spite of these favourable conditions the young birds died in the strangest manner. Various suggestions were made to account for this mortality, of which perhaps the most plausible was that their insect food had been destroyed by the floods of August, 1912 (see 'Zoologist,' 1913, p. 175).

Mr. N. Tracy is to be congratulated on again succeeding in finding a Curlew's nest near King's Lynn on May 13th, and he subsequently ascertained that the eggs, of which there were four, hatched.

The Autumnal Migration.—The autumn migration to the east coast of England, and particularly to Norfolk, commences in August; it continues with fluctuations for three months, and the sequence of species is always pretty much the same, but the number of individuals composing each species varies greatly. If there are strong N.E. winds, a rush of birds may be expected, including rarities from Asia; but if the weather be open, with little wind, the migrants pass over the coast of Norfolk without stopping. This annually invading army may be roughly divided into two great brigades of birds, namely, those arriving in September, when a great host of Wheatears, Redstarts, Warblers of all sorts, Flycatchers, Nightjars, Sparrow-Hawks, and Kestrels deploy on our shores; and, secondly, the great rush in October and November of Grey Crows, Rooks, Jackdaws, Snow Buntings, Sky-Larks, Redwings, and Thrushes. The second inrush is the more noticeable of the two, because the birds are partly day migrants, and so force themselves on man's observation.

Of the three hundred and nineteen species which are considered to be admissible into the Norfolk list, all, except seven, are now known to be migrants.

The autumn of 1913 was too fine for local ornithologists to expect great things, nevertheless the wind blew steadily from the north-east from September 2nd to 8th, and this was favourable for rare birds. Accordingly Mr. E. C. Arnold, who was on the shore every day from September 2nd to 15th, was able to report a steady arrival of birds. But this only went on as long as the wind was from the north-east; on the 9th it changed to west, and at once Mr. Arnold remarked a disappearance of both waders and small Passeres. It was no longer in the right quarter for them, and consequently they ceased to pass. The Ortolan Buntings and Barred Warblers had already put in a fleeting appearance, but few in numbers, and their stay short. The latter must now be looked upon as an annual visitant, given suitable weather, having already occurred in Norfolk about sixteen times. Of these, ten are stated to have come with a north wind, and one with a very gentle south wind, while in four cases the wind's direction was not noticed. All have come very nearly at the same date, namely, between August 27th and September 12th.

The first October rush of birds was registered at Great Yarmouth by Mr. T. Chasen on the 12th, and again another rush was witnessed to the north of that town on the 19th. Further to the north Mr. B. B. Riviere noted a big passage of birds at the mouth of the Wash on October 21st and 22nd, which will be described later on. Very few birds of prey came over; indeed, owing to the present system of persecution in Norway, they get scarcer every year, and although there was an extraordinary plentitude of wasps' nests, only one Honey Buzzard arrived, and that was taken at sea (C. B. Ticehurst).

The Effect of Wind on Norfolk Birds.—If you have not been already troubled with too many theories about birds and wind, I should like to add a few more words on this puzzling subject, which seems to baffle some of the best ornithologists. My old friend Heinrich Gätke, for whose meteorological observations,

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although they have been impugned, I have a great respect, cites "the simple fact that, whereas birds appear in great number when the wind is in a particular direction, they are scarcely seen at all when it is in some other quarter" ('Heligoland,' p. 74). This was the opinion of the veteran observer, but it has been challenged by later writers. In another place he says: "All species, without exception, approach in largest numbers to the earth's surface when very light south-easterly winds, accompanied by clear warm weather, happen to prevail for any length of time in the lower regions of the atmosphere" (T. C., p. 76). If this be true of Heligoland, it is probably equally true of the coast of Norfolk.

It has to be remembered that the wind often changes two or three times in a day, and observers do not always keep pace with these changes. Take the following, which is only one entry among many: "September 9th, 1913. At 7 a.m. the wind was E. at Northrepps, at 9 a.m. it was N.N.E., at 10 a.m. it was N.N.W., at 4 p.m. it was due N." These readings were from the clouds, which I generally find to be the best weather-cock.

Again, there is another point not to be forgotten, namely, that migrants cannot be much affected by any wind except that through which they are passing. Now migratory birds commonly travel high, and it may not unfrequently be observed upon the coast of Norfolk that, while the lower stratum of clouds is moving with the wind at a fair pace, the higher ones appear to the eye as absolutely stationary. Accordingly, if the birds have just descended from a height, it is not the lower stratum which has governed their movements but the upper.

This was first remarked by a very acute observer, Mr. F. D. Power, who formerly visited the Norfolk coast every autumn, and was led by long experience to attach great importance to wind in its effect on birds. In a little work entitled 'Ornithological Notes from a South London Suburb,' which deserves to be better known, Mr. Power says:—"These contrary currents may often be observed in studying the movement of the clouds, and I have many times seen migrants on passage against this higher wind at such an altitude that, had not my attention been attracted by the traveller's notes, I should have missed the movement altogether" (p. 58). Gätke, who observed this, speaks of sometimes hearing the calls of Rooks from above when the birds themselves were too high up to be seen (T. C., p. 207).

Again, when little bands of Passeres, such as Finches, Buntings, Larks, Pipits, Wheatears, and Swallows (bands often composed of four or five individuals only), are to be seen going the wrong way—that is to say, north-west, when they should be going south or south-east—as often happens in the autumn (chiefly in September), it surely must be held that their movements are ruled by wind. These retrograde movements are coastal movements, and are especially to be observed near Cromer. It may be granted that they are partly due to the rounded outline of Norfolk's sea-board, but the main factor is wind.

The Winter Migration consisted of large arrivals as usual of Blackbirds, Wood-Pigeons (especially on November 21st),* Snipe, Wild Duck, Teal (over 200 in one small pond), &c., in December, as well as Waxwings and Woodcocks, the two best bags of the last-named being made at Sheringham (23) and Stratton (22). No Little Auks. As regards Waxwings, their numbers, although considerable, cannot have equalled what were seen in the great Waxwing winter of 1866–7, nevertheless the attention which they attracted was universal; although the whole eastern seaboard of England was visited, it seems to have been in Norfolk that the largest number landed. The credit of adding the Waxwing to the list of British birds has generally been given to Martin Lister, but as a matter of fact it belongs to a Norfolk naturalist, the celebrated Sir Thomas Browne, who was the first to detect this migrant from the north, and the same observer also added the Bearded Tit to our avifauna.‡

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* Which coincides with observations in Kirkcudbrightshire, where, in twenty-five years, the Duchess of Bedford had never seen anything approaching their numbers ('Scottish Naturalist,' 1913, p. 283).

‡ The Waxwing being a very notable and conspicuous bird, early attracted attention in Western Europe, and a good deal might be compiled about it from Continental literature of the sixteenth and seventeenth centuries. Conrad Gesner in his 'Historia Animalium' alludes to an enormous flight of Waxwings in Germany (lib. iii. p. 674):—"Garruli Bohemici anno Salutis MDLII inter Moguntiam [Mainz] & Bingam [Bingen, twenty miles distant] juxta Rhenum maximis examinibus apparuerunt n tanta copia, ut subito qua transuolabant, ex umbra earum veluti nox appareret . . ."

Principal Rarities.—The principal rarities during 1913 were a Sea Eagle in March, an Ortolan Bunting in April, a Night Heron (?) in May, two Roseate Terns in June, a Yellow-breasted Bunting (*Emberiza aureola*), five more Ortolans, and two Barred Warblers in September, a Glossy Ibis in October, and the inrush of Waxwings in November and December. From a beautifully executed drawing of the Yellow-breasted Bunting with which Mr. E. C. Arnold has obliged me, it can be seen how close a resemblance there is to his first one, of which the 'Zoologist' gave a figure (1906, plate ii.). This rare Bunting has been added to Mr. W. R. Lysaght's fine collection.

Weather Conditions.—The autumn was a very fine one, and was protracted far into November, the first sharp frost not occurring until the 23rd of that month (A. W. Preston). Rainfall 23·52. The figures used for denoting the force of the wind are the same as at the Meteorological Office in South Kensington. Force 1 is not enough to move a weather-cock, force 3 is a gentle breeze, and force 5 a fresh breeze sufficient to make smacks shorten sail, while force 7 is a moderate gale, in which they remain in harbour, with a velocity attaining to 32–38 miles an hour.

JANUARY.

1st.—The New Year opened with Thrushes in song, and a day afterwards the Mistle-Thrush and Sky-Lark were also singing at Brunstead, and a Bearded Tit was detected by my correspondent, the Rev. M. C. Bird on the common.

17th.—A Bernicle Goose taken on that once celebrated resort of wildfowl, Breydon Broad, where I have not heard of one since January, 1910 (E. C. Saunders).

20th.—Shoveller at Calthorpe (M. C. Bird).

23rd.—Great flock of Golden Plover at Horsey (M. C. Bird).

26th.—The Bittern's boom heard on the Broads, one of the earliest of spring sounds there. Plenty of Jays about, and more cock Blackbirds than usual.

FEBRUARY.

1st.—At Mr. Robert's to-day a Slavonian Grebe,† a Great Crested Grebe, and a Red-throated Diver,† all just sent from Rockland Broad; the Slavonian Grebe's eye was red, encircled with yellow, but in one which I once had alive this was reversed, it being the inner circle of the iris which was yellow.

MARCH.

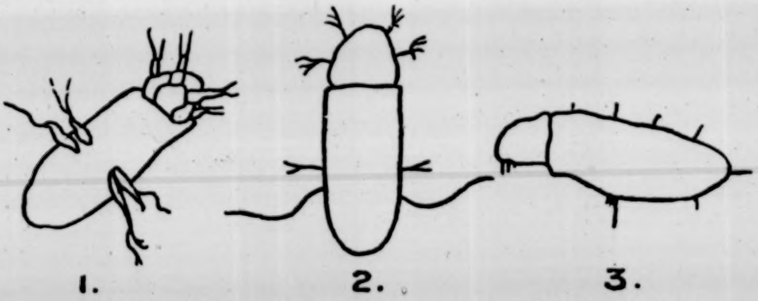
4th.—A Sea Eagle seen at Fritton Lake, near Yarmouth, by Mr. Buxton, flying rather low against a south-west gale; nothing more was heard of it. Sand-Martin at Foulmere (H. Halls).

11th.—W.S.W., 3. The customary departure of Rooks and Hooded Crows was marked at different places on the coast by Mr. F. C. Cook ('Zoologist,' p. 373), the Rev. M. C. Bird, and Mr. Burdett.

23rd.—S.S.W., 4. At about half-past five in the evening Mr. W. Burdett, gardener, was surprised to discover no fewer than sixty Pied Wagtails which had settled for the night on a comparatively short length of wire-netting used for covering fruit in a small garden, about a mile from the sea. These Wagtails are not only highly migratory, but more gregarious than authors have hitherto noticed. As early as February 22nd Mr. F. C. Cook saw over forty, evidently migrating ('Zoologist,' p. 373); these also were near the sea, and a movement was also noticed at Brunstead by Mr. Bird on March 11th.

APRIL.

7th.—A Gannet † caught alive off Sheringham (Sir Digby Pigott), and on the 12th another † also was taken alive at Overstrand, both fine adults. A careful search was made in both for the singular Mite which inhabits the Gannet's large subcutaneous air-cells. This creature, which, though small, is easily discernible with the naked eye, was first described by



1. Under side. 2. Upper side. 3. Side view.

Colonel George Montagu under the name of *Cellularia bassanæ*. Mr. William Evans, who has made a study of parasites in birds, is inclined to suppose that *Cellularia*, when it has reached its adult stage, makes its way through the skin of its host, and might be then found reduced in size, hidden among the Gannet's feathers. This will partly account for the very great difficulty which some have experienced in finding it. If any of your correspondents who may happen to skin a Gannet could secure me a specimen of *Cellularia* I should be extremely obliged, as it is desirable that a better figure of this singular form should be secured than that here reproduced from 'The Memoirs of the Wernerian Natural History Society.'

28th.—S., 3. An adult male Ortolan Bunting taken in a market garden at Yarmouth (E. C. Saunders).

29th.—Bittern booming at Hickling, and a pair of Short-eared Owls seen (Bird).

MAY.

6th.—*The Norfolk Broads.* To the gullery on Hoveton Broad, where there are considered by the owner to be three hundred Black-headed Gulls' nests this year. There are also an exceptional number of Redshanks on the marshes, whose strange quiverings and pirouettings have been so well described by Mr. J. S. Huxley (P. Z. S., 1912, p. 51). An egg of this species, which we found, was taken by Mr. G. H. Gurney and placed under a hen; it hatched out on June 4th, incubation having lasted twenty-four or twenty-five days. By dint of judicious feeding upon ants' eggs and very small worms, this young Redshank did well for four days, and would have lived longer if the hen had not killed it. The great size of its legs struck us as being out of all proportion to its little body. Mr. Arthur Patterson considers that Redshanks were remarkably numerous in the valley of the Waveney, and their abundance this spring has been noticed elsewhere by other observers; in a limited area he estimated a hundred pair, some of which must have bred very early, for Mr. F. Chasen saw young ones which were able to use their wings on April 25th. This increase may be due to protection, or, what is more likely, to the sediment left on the marshes by the great flood of August, 1912, which would probably breed the sort of food Redshanks eat. Prior to this, Mr. Patterson says the Bure marshes were becoming drier every year, and the Broads also are shrinking sadly in places. On June 10th, although not a very warm day, Redshanks were going through their amorous performance at Hoveton with a strange series of quiverings and up and down movements, very hard to describe in words, but not inaptly compared by Mr. Huxley to the motion of a switchback railway. All the time the performance is accompanied by a series of monosyllabic notes, very different from the shrill whistle of autumn and early spring. Although most of it takes place in the air, they sometimes alight on the ground, or even on a gate-post, where they seem quite at ease.

8th.—On the Broads again—always so delightful at this time of the year—this time listening for Bitterns, of which Mr. R. Gurney and I heard one, but not distinctly, owing to too much wind, and for the same reason the Bearded Tits did not show themselves. If it had been a fine day, we should not have been long without seeing the males chasing one another among the brown reeds, which they so much resemble. As the boat was "punted" noiselessly along with what our men call "a quont," a Water Rat, alarmed by its approach, was seen swimming in "the dike" with a young one in its mouth.

9th.—A Coal Titmouse† has now nine eggs in a box in the garden. By the time the young ones are ready to fly, it will be a marvel how those at the bottom escape suffocation, but the Coal Titmouse is fond of close quarters, in which air seems to be of no consequence. It is not an unusual thing for this species to seek the warmth of a haystack, where it finds some convenient hole to burrow into at night, where with a small net it is easily caught.

13th.—Your correspondent Mr. Butterfield asks for information about the Blackcap and Garden-Warbler (1913, p. 431), but I can only say that both these sylvan Warblers have been again scarce. To-day a dead Blackcap was lying on the path—there being no cause to account for its death. A favourite as a songster, this pretty bird is at the same time too much of a fruit eater to be any friend of the gardener's; indeed, it will hardly wait for him to go for his dinner before it sallies forth into the raspberry-canes, where it indulges greedily, going on eating sometimes until the feathers of its face are smeared with the red juice.

The Willow-Warbler has a better reputation, but I have so often seen him among my raspberry-canes that it is impossible to acquit him of a *penchant* for the fruit also, although this species is stated in the fourth edition of Yarrell's 'British Birds' (i., p. 434) not to eat it.

14th.—The increase of the Common Linnet calls for a word or two; in this parish more than a score of nests came under observation in a very limited area, and our market gardeners are calling out loudly, accusing it of doing a great deal of harm to the seeds and young growth of radish, lettuce, and cabbage crops.

16th.—A Night Heron reported to be on Holkam Lake, also a Ruddy Sheld-Duck, but this may have escaped (S. K. Long).

25th.—A Quail † found by Mr. F. Chasen under telegraph-wires at Yarmouth; a Mistle-Thrush was also "telegraphed," and another † washed up by the sea.

JUNE.

2nd.—Mr. B. Dye states that nine Grey Plover were seen on Breydon Marshes, and again on the 9th eight were seen, possibly the same birds, all of course in summer plumage. I once saw four at Blakeney so late as June 14th, but their occurrence at this season is somewhat remarkable, and must be confined to individuals which have no intention of breeding surely.

11th.—By dint of protection the Bearded Tit, or "Reed Pheasant," as our marshmen call it, now holds its position. Fifteen or sixteen years ago, owing to the rapacity of one or two dealers, there were probably not thirty nests from which the young got clear away in the whole Broad district, but now eighty or even ninety nests would not be too liberal an estimate. They are early breeders, and to-day some were feeding young ones, but young Bearded Tits are to be seen as big as their parents by the middle of June. The eggs, five or six in number, are occasionally laid at the end of March, and have a pink tinge when fresh, which is lost in blowing. In April Mr. B. B. Riviere was shown a nest containing ten eggs, seven of which were in their proper place in the nest, and three more were showing through the lining. I once heard of a nest at Hickling with twelve eggs, but in both these cases they were probably two clutches, laid by different females, the second having been deposited after the first was forsaken. Common as is the Cuckoo on our Broads, I have only once heard of its selecting a Bearded Tit's nest for its egg, and in that case, as the clutch was taken, there is no proof that the young Cuckoo would have been reared by its foster-parents.

17th.—Eight Oystercatchers on Breydon Broad (G. Jary).

18th.—There is now an Oystercatcher's nest † at Blakeney with three eggs, and another with six (see photograph), the produce of two hen birds in the opinion of Mr. William Rowan, who spent some time at the Point with Professor Oliver. I learn from Mr. Rowan that a third nest was discovered containing three fresh eggs, which a Rook subsequently ate, and that Oystercatchers were locally considered to have been more numerous in 1913 than for some years.

Eggs of Oystercatcher.

20th.—Enjoyed another excursion with Sir E. Gurney to the Broads, where there is always something to see, but we were sorry to miss the pair of Montagu's Harriers from the marsh where they had been last year. However, this disappointment was more than balanced when a little before half-past five a fine Bittern was viewed approaching with lazy flight, extended legs, and retracted neck from the same direction as one had come when Mr. Bonhote and I were on this Broad one warm July day two or three years ago. On perceiving itself watched by three people, it rose considerably, but soon dropped again to its original level, some fifteen feet above the reeds, among which we eventually saw it settle. I should have liked at once to have searched for the nest, but the owner was obdurate, fearing that the birds might forsake it, a feeling with which one could not but sympathise. The return of the Bittern to Norfolk of late years has been accompanied by a general desire to protect it on the part of the Broad owners, and it is hoped that this good action will have the support of the public who use our Broads in summer. The "boom" of a Bittern is a curious sound, not often to be heard; it is hushed in the middle of the day, but towards evening this nocturnal "Butter-bump" as it has been called in allusion to its note, becomes more lively. By listening carefully, we could easily distinguish five successive "gasps," rising *in crescendo*, and terminating in the deep "bump," whence its name, but sometimes there were only three "gasps," which agrees with the statement of Francis Willughby that the number is always uneven.* Whether it goes on serenading its mate all night is hard to say; on the present occasion I can testify that its "boom" could be heard up to 11 p.m. and again at 4 a.m. the next morning—*i. e.* sixteen minutes after sunrise—breaking forth about once in four minutes, and this went on with clock-like regularity until past six o'clock. I believe it is not yet settled whether the female Bittern can boom or not, but at any rate she does not do it nearly as loud or as often as the male. Mr. W. P. Pycraft in a recent article ('The British Bird Book,' iv., p. 338) leaves the question open, merely remarking that the syrinx, which is usually considered to be the voice organ in birds, presents no modification. An old eighteenth century naturalist, Dr. Lamb, however, mentions having found in repeated dissections a loose membrane on the inner side of the windpipe in the male, which the female does not possess ('Zoologist,' 1880, p. 318). It is through the nostrils, which are distinctly larger than a Heron's, that the sound is believed to come.

24th.—A pair of Roseate Terns identified at Blakeney Point by Mr. Bishop, and also by the bird-watcher, who were both near enough to see their rosy breasts, besides at once noticing the

* "Boatus numero impari vel tres simul, vel quinque edit, ut aiunt" ('Ornithologiæ Libri Tres,' p. 208).

difference in their cry of "crake, crake," harsher than that of the Common Tern. Although not remembered by these observers, the 24th was the identical day on which two Roseate Terns† were shot here by a boy in 1896. A pair were seen also at Wells in June, 1897 (Norwich Nat. Trans., vi., p. 512), and another at the Point in May and June, 1902, and they are even supposed to have nested at Hunstanton ('Ootheca Wolleyana,' ii., p. 301). This species seems to be on the increase (*cf.* 'British Birds,' vii., p. 242), and the Arctic Tern to be getting rarer—at least on our coast.

25th.—Two nests of the Lesser Tern, and afterwards a third nest, all with eggs, found by Mr. F. Chasen near Yarmouth, where they are not known with certainty to have bred for many years. At Wolferton, Mr. G. Cresswell reports first eggs of the Common and Lesser Terns on May 13th, and the first young of the Common Tern on June 5th and of the Lesser on June 4th. Here they generally use the shingle for their nests, but at Blakeney the marram grass (*Psamma*), and perhaps in rare instances the shelter of *Suæda* bushes (*S. fruticosa*).

30th.—*Blakeney "Ternery."* Last year's report commented on the flourishing state of this well-protected ternery, and on the increase of Sheld-Ducks, of which, on the 30th, Mr. C. Gurney and I put up thirty-nine, showing how they have responded to protection (see 'Zoologist,' 1886, p. 93, and 1887, p. 141). With the Terns we were very much disappointed, for not only was the number less than had been seen on previous visits, but also there had been a most unfortunate mortality among the young, three-fourths of which were lying dead on the sand, and other downy mites were scarcely able to crawl. The watcher in charge considered that they had been starved by lack of Whitebait, their usual food, he having opened several nestlings and found no food in them. Mr. William Rowan, who was staying at the Point* some ten days later, remarked on the

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* In 1912 Blakeney Point was purchased from Lord Calthorpe by "The National Trust for Places of Historic Interest or Natural Beauty," and a small house has been built on the sand-hills for the use of botanical students, under the leadership of Professor Oliver. During the first week in July about one hundred and thirty Terns and fifteen Lesser Terns were ringed under his direction by Mr. Rowan, with rings supplied by Mr. Witherby.

Whitebait to be seen lying about in numbers among the Terns' nests, whither they had been brought by the parent birds for their dying young, by that time too feeble to eat them ; or it may have been that the fish were too large. One can hardly imagine a nestling Tern making a meal of a Sand-Eel as large as the one which is being offered by the bird in the photograph, but in some cases, as suggested by Mr. Rowan, the old Terns may have been kept off their nests too long by visitors. The Terns at Wells are reported to have suffered in the same way, but not those at Wolferton.

Lesser Tern feeding young one.

July.

29th.—A Tufted Duck and five young ones seen on the Bure at Salhouse by Mr. H. C. Davies, and afterwards by Mr. Barclay, were identified beyond dispute. A nest had been previously reported to Mr. B. B. Riviere by one of the gamekeepers, which doubtless produced this brood ; it may have belonged to a male which Mr. Barclay and I saw on Hoveton Broad on June 11th, and to a female which had been "pricked," and was known to be about in that neighbourhood. The nesting of the Tufted Duck on this side of Norfolk is of very rare occurrence, but I am informed by Miss Turner that in 1912 a pair nested and had eggs at Hickling, but being disturbed, forsook their nest. Mr. Riviere says there have been three Pochards on Rockland Broad nearly all the summer, and earlier in the season on another large Broad he identified three Garganey Teal.

August.

6th.—A Green Sandpiper † received by Mr. Roberts, and on the 10th there were four † together at Intwood stream, a part of which had been emptied of water for the removal of mud, and on the 15th another at the same place. This is called "fyeing out" a stream in Norfolk, and it is extraordinary how quickly these Sandpipers find out when this operation has taken place, leaving exposed what is to them a rich feeding ground, which possibly they discover by a sense of smell, an organ much more acute in birds than is generally supposed. During the present summer a pair of Green Sandpipers have been continually seen on a large pond at Hanworth (G. Davey), where in September they were joined by three more, which, from their lighter tints, Colonel Barclay judged to be young ones. The odd thing is that these Sandpipers are also here in the depth of winter; at which season I have repeatedly seen single Green Sandpipers in December and January.

29th.—The Grey Wagtail † arrived, before its usual time; this species is said to have bred in Suffolk ('The Field,' October 1st, 1910).

September.

1st.—Two young Arctic Terns † shot at Yarmouth (F. Chasen).

2nd.—*September Migration.* At 4 a.m., and probably much earlier, migration was in swing with a gentle wind from the north-east, for although it was still too dark to discern the feathered travellers, Mr. F. Chasen could recognize the calls of Dunlin, Ringed Plovers, Terns, Curlews, Oystercatcher (1), Sandpiper, and Turnstone, possibly attracted by the still burning lights of Yarmouth. At Cromer, where the wind was S.E., 2, at 2 o'clock and E. at 7 p.m., several migrants were noted by different people. So were others by Mr. E. C. Arnold at Blakeney, where the wind was the same as at Yarmouth, *viz.*, N.E., 2, and these included the rare Barred Warbler. Another

Barred Warbler was identified by Mr. Richards on or near the shore, as well as three or four Ortolan Buntings, and a few Bluethroats; these latter always an indication of the great September movement being in progress.

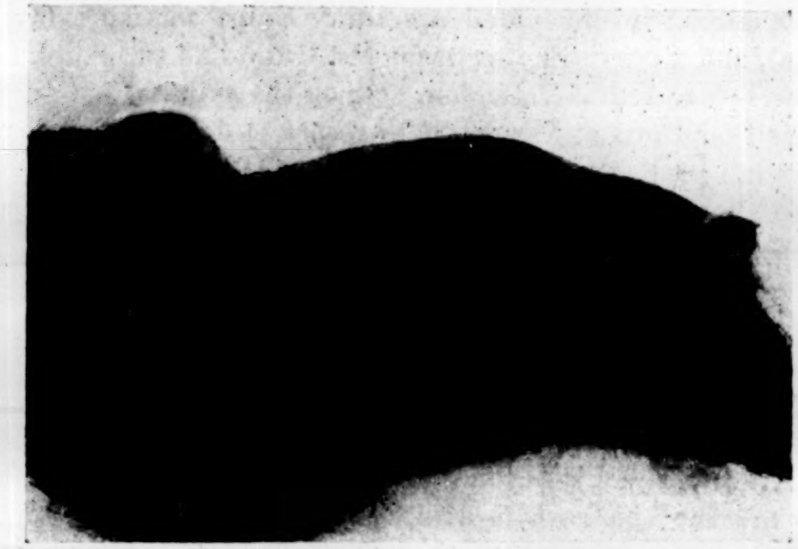
3rd.—E.N.E., 2, at the mouth of the little river Glaven, where a Razorbill and a Great Crested Grebe in the estuary marked its continuation; while inland a solitary Snipe was shot (T. E. Gunn), and a few days afterwards Mr. Gunn had two more.

4th.—Mr. Arthur Patterson, ever on the *qui vive*, had a wave of small migrants at Yarmouth to record to-day, the town park being full of Redstarts, Willow Warblers, Robins, &c., so that Mr. Patterson thought there were seventy in one clump of shrubs. Birds of all sorts were now on the move, and Mr. Arnold, with his usual good fortune, annexed a Yellow-breasted Bunting (*Emberiza aureola*) near "The Hood." In his diary the wind is entered as N.E., 1, with a squall, while in mine it is marked as E., 2, at 8 a.m. The two previous occurrences of this Asiatic Bunting were with a very light N.W. wind (1), and a N.E. (4). There is nothing to beat a strong east or north-east wind to bring a big rush, as witness what happened in September, 1903 (see 'Zoologist,' 1904, p. 209). But besides rare birds, there was great restlessness among some of the commoner ones, especially Whinchats, of which species about forty were counted in one small field of cut peas, about a mile and a half from the sea, and that in a parish where at other times they are unknown, but, like the Redstarts, they did not stay long.

6th.—At 8 a.m. the wind at Northrepps was N.E., 1, where fifteen minutes later the gardener saw a Greater Spotted Woodpecker fly over the house, followed a few minutes afterwards by a Wader whistling loudly. This was the day on which the first Bluethroats were seen at Lowestoft by Mr. C. B. Ticehurst.

9th.—S.W. to N.W., with rain at Blakeney. House Martins passing along the beach (Arnold). Six Sand Martins † going north-west against the wind at Overstrand. Swifts passing at Stalham (Bird).

10th.—The old Cuckoos have all left, but the young are now on migration. To-day Mr. E. T. Roberts received a well-grown young bird, evidently a flier, and having the curiosity to examine its stomach, found therein on dissection a dense mass of rather long hairs, which had effectually insinuated themselves into the lining of the bird's gizzard. There were three good-sized caterpillars in its throat, still undigested, and these resembled the larvæ of the Tiger Moth or Fox Moth, both of which are very hairy, and no doubt similar larvæ supplied the hairs in the gizzard. That somehow or other caterpillars' long hairs frequently find their way into the cuticle of the gizzards of Cuckoos has long been known, but it must be rare to find so many as in the present case.*



Stomach of a young Cuckoo.

14th.—At 7 a.m. the wind was S.S.E., 3, but at Blakeney it veered round to N.E., with thunder, and here a large migration of House Martins and Swallows, as well as of Linnets, came under Mr. Arnold's notice. The great number of House Martins which in September travel through East Norfolk has been before alluded to ('Zoologist,' 1906, p. 133, and 1909, p. 130), and a plausible suggestion thrown out, namely, that they follow the western shore of the North Sea, and not the eastern.

15th.—N.E., 2. Several Kingfishers reported by Mr. Arnold as being at no great distance from the shore had possibly crossed the sea in the night.

* My late father recorded the presence of hairs in *Oxylophus serratus* ('Ibis,' 1859, p. 246).

23rd.—Two Crossbills at Northrepps (W. Burdett), and one on October 1st, nor did I hear of any more in East Norfolk until December 11th, when I saw two † at Hempstead on Scotch firs.

25th.—Several Jack Snipe already over (Bird); a Bean Goose shot on Breydon (Saunders).

October.

1st.—E., 5. No migration remarked by any of my correspondents, but it was probably going on, as the wind was high, and the next morning Mr. Chasen found a Wheatear and two Sky-Larks killed by telegraph-wires, and noticed several Robins on the beach.

7th.—*October migration.* W., 1. At an early hour (7.30 a.m.), going on to the beach between Yarmouth and Caister, which, like Blakeney further north, seems a favourite landing-place, Mr. Chasen at once perceived that an extensive migration had set in during the night, and was in full progress, Chaffinches, Linnets, Sky-Larks, Starlings, Crows, &c., all coming from the north-east.

16th.—Several Siskins and a Mealy Redpoll (B. Dye).

19th.—S.W., 2. Another big migration noted at Yarmouth by Mr. Chasen, the birds coming as before from the north-east. Searching under the telegraph-wires he found two Starlings, two Titlarks, one Redwing, one Blackbird, and a Jack Snipe, all quite fresh, probably killed during the night.

20th.—An Eared Grebe brought in to the birdstuffer's. Seven Shore-Larks taken in a clap-net (B. Dye).

21st.—S., 3, at Yarmouth. Mr. B. B. Riviere writes:—"At Hunstanton there was a falling glass, rain, and S.W. wind. During the whole morning up to mid-day there was a large migration of Sky-Larks, Starlings, and Lapwings, with a few flocks of young Rooks, and three or four larger flocks of Linnets. All the birds were following the coast-line, coming out of the east beyond Holme, passing Hunstanton, and turning south-west along the shore of the Wash towards Heacham. In the afternoon I saw a Wheatear and a Black Redstart."

22nd.—W.S.W., 1, at Yarmouth. Mr. Riviere writes again:—"At Hunstanton with very light S.W. wind. From 7 o'clock in the morning until mid-day there was a very big passage of Chaffinches, Greenfinches, Linnets, Sky-Larks, Starlings, Rooks, Lapwings, Meadow-Pipits, and Reed Buntings, all following the coast-line in the same direction as on the day before. I also saw a flock of Shore-Larks on the beach, and two more Black Redstarts."

23rd.—Finches and other birds still coming in from the sea near Yarmouth (Chasen).

28th.—Gossy Ibis † at Acle ('Zoologist,' *ante*, p. 37).

November.

6th.—A Firecrest was shot at Cley by Mr. H. P. Williams.

14th.—A number of Rock-Pipits on Breydon Broad embankment (B. B. Riviere).

15th.—Mr. Arthur Patterson received a Waxwing from St. Olave's, to be quickly followed by others, and for eight or ten weeks they continued coming over the sea. Altogether the presence of about one hundred and six was announced, for the most part near the coast, but very likely some were counted twice over. Most observers were content to watch them, and the number shot was not great, the most received by any one taxidermist being fifteen; this was the more creditable because of their great tameness, which was remarked in several cases, possibly in part due to exhaustion, but they are said to be very tame in Finland. An interesting observation was taken at Cromer on February 7th by Mr. Henry Cole, who early in the morning (about 7.30 a.m.) saw, at no great distance from the sea, a little flock of about fifteen, apparently then landing from the Continent. Owing to the great scarcity of berries, a good many of the Waxwings betook themselves to gardens, where there was a better chance of finding food, and some even penetrated into Norwich, six appearing in Earlham Road, two in Newmarket Road, and one in Surrey Street, where it had the ill-luck to get down a chimney (R. Mills).

December.

2nd.—House Martin at Haddiscoe (H. Cook).

10th.—A Land-Rail hanging up in a Yarmouth game-shop (Chasen).

20th.—About this date Mr. Gunn had a Black Redstart from Holkam; on the 28th Mr. F. H. Barclay saw one on Cromer lighthouse hills, and a week after that one was caught so far inland as Hollesdon.

30th.—A cock Pheasant † weighing 5 lb. shot at East Walton (Birkbeck).

MIGRATORY GULLS COMING INLAND.

In October and November the farmers round Norwich are fond of manuring their fields with what are sold as "gyps," *i. e.*, the gills and insides of Herrings. As eight hundred and twenty-four million (824,000,000) Herrings were brought into Great Yarmouth this autumn, "gyps" were cheap. Unless this unsavoury garbage is ploughed in quickly it becomes a great attraction not only to the Black-headed Gulls, but to the larger species too, which somehow find it out, and come inland in large numbers, so that it is not unusual to see two hundred Gulls on a single field, and that even in mild weather, when there ought to be no shortness of other food. Whether these Gulls are to be regarded as migrants or as partial residents is hard to say.

In this connection reference may be made to the Report recently issued by the Suffolk and Essex Fishery Board on the food of Gulls, and since brought before the Norwich Museum Association, in which the following analysis of a number of dissections is given.

Contents other than Fish found in Black-headed, Common, and Herring Gulls.

	Black-headed Gull.	Common Gull.	Herring Gull.
	Per cent.	Per cent.	Per cent.
FISH of all varieties present in	28	24·5	18·2
„ useful as human food present in	13·5	17·5	10·4
„ useless as human food present in......	14·5	7·0	7·8
MARINE FOOD OTHER THAN FISH.			
Shrimps (*Pandalus* and *C. vulgaris*)	27·0	14·6	5·2
Lugworms (*Arenicola marina*)	7·6	2·4	—
Ragworms (various *Polychætæ*)	6·7	3·7	—
Molluscs	4·8	3·7	7·8
Small Crustacea......................	8·5	2·4	2·6
Crabs (various shore Crabs)............	7·7	7·3	16·9
Echinoderms— Starfish, Brittle Stars, Sea Urchins	—	—	18·2
Whelk-spawn (*Buccinum undatum*)......	—	—	10·4
LAND FOOD.			
Earthworms	18·3	18·5	6·5
Wireworms	3·8	·0	·0
Beetles...............................	9·6	1·2	1·3
Craneflies............................	5·7	11·0	1·3
Other insects	3·8	8·5	1·3
Cereals	2·9	11·0	19·5
Garbage	3·8	13·4	11·7

TENACITY OF THE WEASEL.

An incident of instinct at fault, which is not without precedent, but shows the extraordinary tenacity of the Weasel in holding on to its prey, must be related in conclusion.

Sometime during November (exact day forgotten) Lady Layland-Barratt, who was driving her car near Happisburgh, was greatly surprised at seeing a Hawk—presumably a Kestrel—rise from the ground with a Weasel, not in its talons but suspended from the bird's breast, which it was apparently hanging on to with its teeth. The Hawk soon dropped to the ground, but rose a second time with the Weasel still hanging on, and flew heavily and with apparent difficulty over a field, where it was lost to view. It was a case of the biter bit, and it is a pity we cannot know the sequel. As the scene was near the sea, the Hawk may have just come over, and in the early morning light seized the Weasel in mistake for a Mouse, an error which probably cost it its life.

THE FAUNA OF "RESERVOIR-PLANTS."

By Hugh Scott, M.A. (Cantab.), F.L.S., F.E.S.
(Curator in Entomology in the University of Cambridge.)

It has long been known that a number of insects and other animals are to be found in the water and detritus which accumulate in the hollow leaf-bases and other receptacles possessed by various tropical plants. But perhaps it is not a matter of common knowledge how extensive and diversified is the fauna dwelling in such situations, how largely peculiar it is to its habitat, and how remarkable in some cases are its relations to its curious environment. The present writer became interested in this subject in 1908–9 while engaged in collecting the invertebrate fauna of the Seychelles Islands, and his interest was increased in 1912 by a slight examination in Trinidad of the fauna of certain epiphytic *Bromeliaceæ*. These latter are the most interesting of all reservoir-plants, and much has been written of their fauna. Recently there has appeared a long and most interesting paper entitled "Les Broméliacées épiphytes considérées comme milieu biologique,"* in which the author, Monsieur C. Picado, embodies the results of an extended study of the inter-relations between these plants and their fauna. Therefore it may not be inopportune to attempt to give some general account of the fauna of reservoir-plants as a whole, and of *Bromeliaceæ* in particular, in relation to its environment.

Many widely different plants possess receptacles of one kind and another in which water can accumulate, and it seems best to adopt Picado's name "*reservoir-plants*" to include the whole of them. The term "terrestrial waters" is used to denote pools, &c., on the ground, as opposed to those elevated above the ground in plant-receptacles.

Permanent marshes and other standing terrestrial waters do not usually exist in the heart of great tropical forests. Owing to loss of water by transpiration, draining of the soil by roots, and other causes, *tropical forests and permanent marshes are to a large extent mutually exclusive.* The same thing applies, though less markedly, to many temperate forests. If then there are no permanent marshes over large areas of tropical forest, how does this affect all the animals which, either throughout their whole lives or in certain stages of them, are dwellers in marshes and pools? Are such creatures absent from the forests? On the contrary, many amphibious and aquatic creatures exist in such forests, and they are able to do so *because the place of terrestrial pools and marshes is taken by accumulations of water in reservoir-plants.* In some of these the water collects only at times, in others it is permanent. But in most parts of the world, and more particularly of the tropics, great forests contain reservoir-plants of some kind. It is not attempted here to give an exhaustive list, but let us review briefly the *principal* kinds and the fauna which has been found to inhabit them.

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* Bull. Sci. France et Belgique, sér. 7, vol. 47, fascic. 3, 1913, pp. 215–360, pl. 6–24.

(A.) First there are certain plants which hold water only *accidentally*, and then only for a time. The most important examples are the bamboos, which often hold water in the ends of broken stems, in the spaces between sheathing leaf-bases and stems, &c. Such accumulations of water have been found in Malaysia to contain larvæ of Culicid and Chironomid flies, and of Dragonflies, and in Central America to contain larvæ of Mosquitoes of the Megarhine group.

(B.) True *reservoir-plants*: these are plants which quite normally possess water- or detritus-holding receptacles.

First may be mentioned the order *Musaceæ*. *Musa*, the banana, holds water between the stalks of its great leaves, and in the New World tropics *Heliconia* holds water in its gaudily-coloured, cup-like floral bracts. These plants are said only to hold water temporarily, but in both have been found certain aquatic insect larvæ, especially those of Mosquitoes.

Next, one may refer to the well-known pitcher-plants, *Nepenthes*, of the Old World tropics. In these the midrib is prolonged beyond the lamina of the leaf, and bears at its end the pitcher. Insects attracted by the honey-glands of the pitcher are drowned in the water which it contains, and the plant absorbs the products of their decay. Dipterous larvæ of several families (*Culicidæ*, *Phoridæ*, *Anthomyiidæ*) have been found living in these pitchers. If it be true, as is asserted, that the plants actively secrete a digestive product to act on the substance of drowned insects, then it is noteworthy that the living larvæ withstand the action of this digestive product and flourish in the pitchers.

Passing back to the New World, one finds, in the temperate forests of part of North America, the Sarracenias. In *Sarracenia* nearly the whole leaf forms a long narrow pitcher. In these pitchers the water often dries up; nevertheless larvæ of *Culicidæ* and *Chironomidæ* have been found in them, certain of which are regarded as peculiar to this habitat. It is stated that the Culicid in question, *Wyeomyia smithi*, Coq., lays its eggs in the pitchers even when the latter are dry, and that hatching is deferred till the pitchers refill with water.

In the Hawaiian Islands a species of *Eriocaulon* provides a habitation for the larvæ of a Culicid and for a species of Cyclopid Crustacean. This case is different in several respects from the others under consideration. The plant is a perennial herb with grass-like leaves, and it was found, not in forests but floating on a marsh; in spite of this, investigation failed to reveal the presence of the animals mentioned in the surrounding waters of the marsh—they were detected only in that between the leaves of the plant.

Among the *Liliaceæ* there is the well-known discovery of Perkins, also in the Hawaiian Islands; that is, that the hollow leaves of a plant of this order are inhabited by certain Agrionid Dragonfly larvæ.

Palms.—In the mountain-forests of the Seychelles * the present writer found a fauna, numerous both in species and individuals, inhabiting the spaces between the overlapping leaf-bases of certain endemic palms. These spaces contained not water but moist organic *débris*. The fauna was principally coleopterous, and included representatives of *Aphodiinæ*, *Scydmænidæ*, *Pselaphidæ*, *Staphylinidæ*, &c., several of the species being found nowhere else. Only some of the palms have their leaf-bases so formed as to hold detritus. In others the spaces are far too narrow, and consequently contain neither *débris* nor fauna.

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* Trans. Linn. Soc. London, ser. 2, Zool., vol. xiv., 1910, p. 24.

The *Pandanaceæ*, or "screw-pines," are trees with stilt-roots and heads of spirally-arranged long narrow leaves. The leaf-bases overlap in such a way as to form abundant spaces capable of acting as reservoirs. In both the Hawaiian and the Seychelles Islands* animals have been found inhabiting them. In the mountain-forests of the Seychelles the water in these plants is permanent, and they were found to contain a varied and interesting fauna, including Woodlice, Snails, Earthworms, a

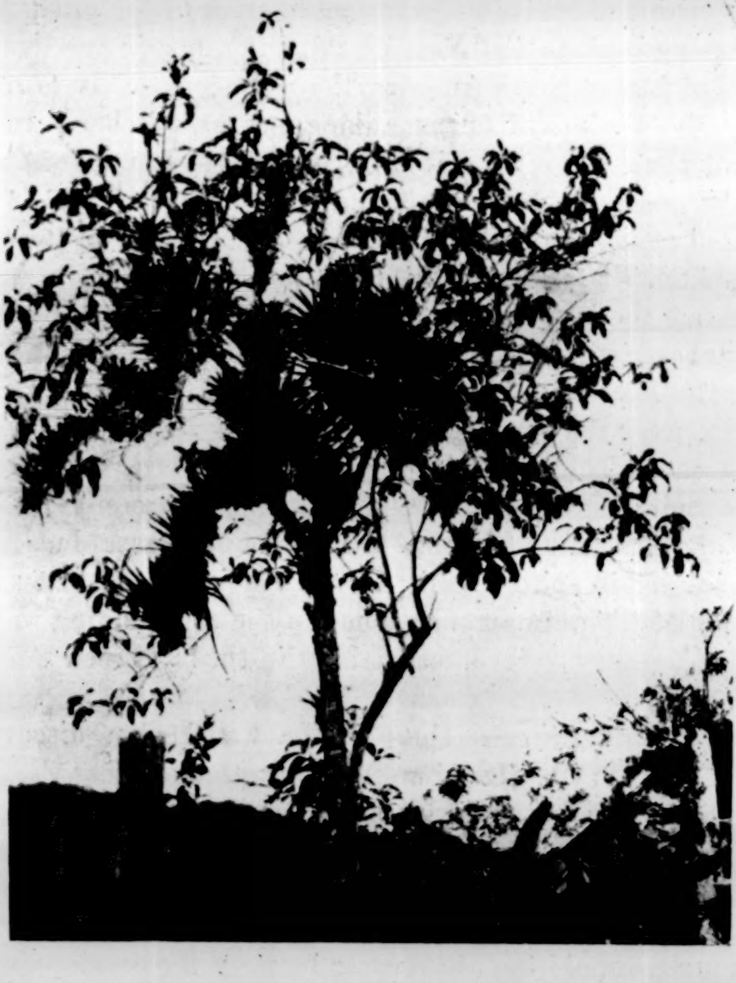

FIG. 1.—A small tree (*Acnistus arborescens*) bearing a large number of epiphytic bromeliads (*Tillandsia*); Costa Rica. (After Picado.)

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* Trans. Linn. Soc. London, ser. 2, Zool., vol. xiv., 1910, p. 24.

Land-Leech, a Land-Nemertean, lepidopterous larvæ, larvæ of a Drone-fly (*Eristalis*), various Coleoptera, including a true Water-Beetle (*Copelatus*), and a peculiar flattened Cockroach. The *Eristalis* larva and the *Copelatus* are purely aquatic. They were never found elsewhere but in *Pandani*, and indeed in several localities where they were obtained there was no other water for them to inhabit. The *Pandanaceæ* are confined to the Old World tropics, and, regarded simply as reservoir-plants, they appear to occupy somewhat the same place in the Old World as the *Bromeliaceæ* do in the New.

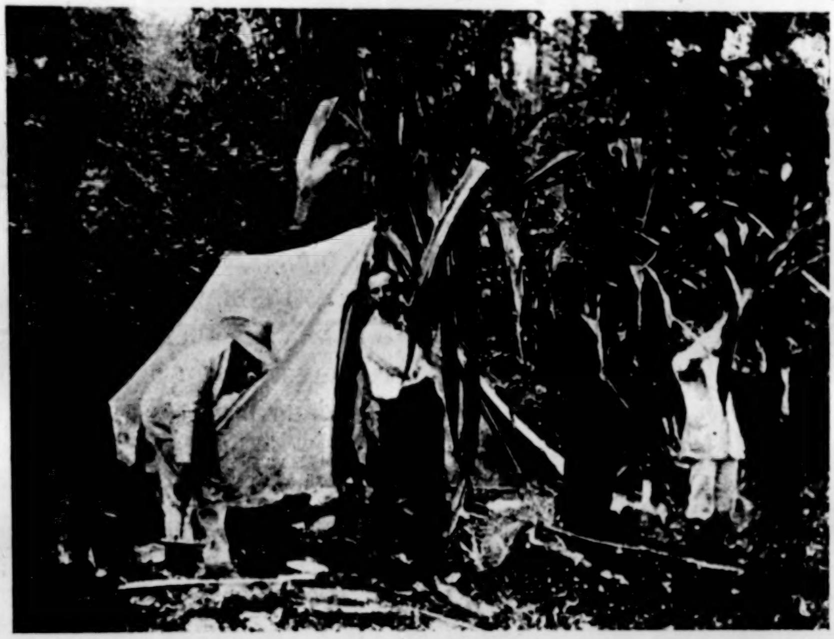

FIG. 2.—Various epiphytic *Bromeliaceæ*; Costa Rica. (After Picado.)

It is to a consideration of these last, the *Bromeliaceæ*, most important and most interesting of all reservoir-plants, that one now passes. They have usually an exceedingly short stem and a rosette of fleshy leaves arranged so as to form a kind of funnel admirably adapted for holding water and *débris*. The majority of forms are epiphytes, *i. e.*, they grow, not on the ground but on trunks and branches of trees, and it is with the epiphytic kinds that we have to do. Some *Bromeliaceæ* grow on the ground—the pineapple is one such—but these do not concern us, since their leaves are not so constructed as to form permanent water-reservoirs.

The *Bromeliaceæ* are confined to the tropics of the New World, and to understand their importance as reservoir-plants, one must realize the immense numbers of individual bromelias of the epiphytic kinds which are present throughout great forest areas in Central and South America and the West Indies. They are one of the most striking features of neo-tropical vegetation, and in many places are so numerous that they seem to push and crowd one another to obtain a foothold on branches of trees. Figure 1 shows a large number of a species of *Tillandsia* growing on quite a small tree; in figure 2, large specimens of more than one epiphytic kind are seen held up to view. For these two figures and the diagram (figure 3) I am indebted to the courtesy of Monsieur Picado, in whose paper they were published; as I possess no photographs of bromelias he has allowed me to republish these. In many places where these plants abound, there is no other permanent water save that which collects in them; I have myself seen a big area of forest covering a mountain-top in Trinidad, and other pieces of forest in Dominica, where this was so.* The bromelias and their contained water and detritus may be regarded, as Monsieur Picado has most aptly expressed it, as a great permanent marsh, broken up into countless small parts, which are elevated at various heights above the ground.

Environmental conditions of the "bromelia-marsh" and their effect on the fauna.—The bromelia-marsh has several other peculiarities as a habitat for marsh-living animals. First, in many places the water never dries up. Though it may evaporate considerably during the hot hours, it is *daily* replenished by the condensation of atmospheric vapour in the form of mists, as well as being frequently reinforced by rain. Secondly, the water is *not* foul. Though containing animal and vegetable *débris*, it is free from accumulation of decomposition-products. This most important fact is due to the action of the plants themselves. The roots of epiphytic bromelias usually act only as holdfasts, fastening the plant firmly to the branch on which it grows, but taking no part in its nutrition. The plant lives entirely on the water and detritus which it collects between its own leaves. It has special absorbent scales on the lower part of its leaves, and these scales take up not only water and inorganic salts but organic substances as well.* Hence the purity of the water; hence also the fact that the solid *débris*, deprived of inorganic salts and of organic decomposition-products, consists very largely of cellulose, which substance is present in much larger proportion than it is in the mud of most terrestrial marshes.

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* Ann. Mag. Nat. Hist., ser. 8, vol. x., 1912, p. 424.

Thirdly, if a vertical section of an epiphytic bromelia be made (see fig. 3), it is seen that the inner part, where the leaves are still alive, forms a number of water-holding compartments. So closely do the leaves fit that these interfoliar spaces are *isolated from one another*, so much so that the water in them stands at different levels. This inner part of the plant has been termed by Picado the "*aquarium*." The outer part, consisting of the stumps of dead and fallen leaves and of solid *débris* formerly accumulated in the interfoliar spaces, is termed the '*terrarium*"; in it the compartments are not isolated from one another.

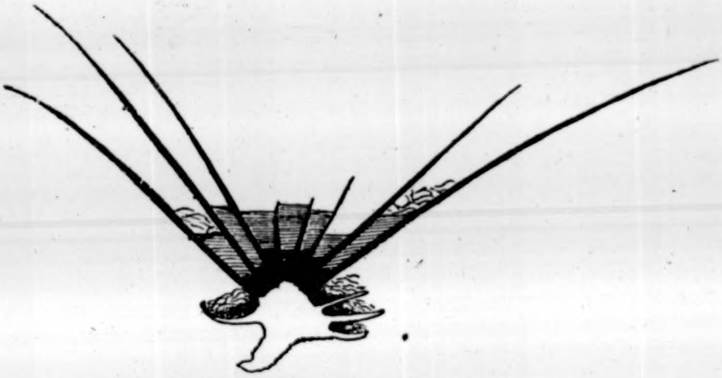

FIG. 3.—Diagrammatic vertical section through an epiphytic bromeliad; explanation in text. (After Picado.)

Now, plainly, all this must have a far-reaching effect on the fauna inhabiting these plants. (1) The geographical distribution of many forms of life is affected, since the bromelia-marshes are present over great areas of country where aquatic and amphibious creatures could not otherwise find any habitation. (2) The water being permanent, many bromelia-dwellers have no fixed season for egg-laying, but may be found in various stages of development at all seasons. (3) The purity of the water is of great import, for many animals can live in the bromelia-marsh which could not exist in foul waters. (4) The isolation of the compartments of the "aquarium" affects some creatures. For example, the bromelicolous larvæ of certain Megarhine Mosquitoes are very cannibalistic, and though a number may hatch and start life together in a single compartment, after a time only one survives. Thus frequently a single full-grown larva is found in each compartment, and probably, if the compartments were to intercommunicate, many less larvæ would survive than actually do.

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* The fact that bromelias absorb inorganic salts through their specialized scales has long been known, but their power of taking up organic substances has not been so fully understood. Picado's paper is largely concerned with this latter point. As the result of an elaborate series of experiments, he concludes that the plant actively secretes a definite substance which acts chemically on decomposition-products. But it is beyond the scope of this article to enter into this matter in detail.

The bromelia-fauna.—Having now considered the nature of its environment, let us turn to the fauna itself. A knowledge of its existence dates back certainly as far as 1879, when Fritz Müller published his discoveries of certain bromelicolous animals in Brazil. Recently many contributions to the subject have been made by a number of writers. The researches of Calvert and of Picado in Costa Rica have added especially to our knowledge of this fauna.

The latter author, in his work already cited, gives a list of about two hundred and fifty bromelicolous species. Many (but not all) of these are considered to be *exclusively* bromelicolous, *i. e.* not to occur elsewhere. A full discussion of the reasons for this would be lengthy, but it may be stated that, first, many aquatic animals are found in bromelias over large areas in which there are no other waters suitable for their existence; secondly, in some cases, when terrestrial waters are present in the vicinity, careful search has failed to reveal in these the presence of the bromelicolous species.

The opinion is expressed by Picado that, in proportion to the restricted nature of the environment, the bromelia-fauna is as diversified as any in existence. The following groups are actually known to be represented in it:—

- Protozoa.
- Rotifers.
- Planarians.
- Leeches.
- Oligochæt Worms.
- Gasteropoda.
- Crustacea (Ostracoda, Copepoda, Isopoda).
- Insecta:—
  - Thysanura.
  - Earwigs.
  - Cockroaches.
  - Other Orthoptera.
  - Thysanoptera.
  - Hemiptera.
  - Ants.
  - Perlid larvæ.
  - Dragonfly larvæ.
  - Caddis-fly larvæ.
  - Lepidopterous larvæ.
  - Beetles and beetle-larvæ of a number of families, including a true water-beetle (Dytiscid).
  - Dipterous larvæ, including *Culicidæ*, *Chironomidæ*, *Tipulidæ*, *Rhyphidæ*, *Borboridæ*, *Anthomyidæ*, *Syrphidæ*.
- Peripatus.
- Myriapoda.
- Acari.
- Phalangids.
- Pseudoscorpions.
- Scorpions.
- Spiders.
- Vertebrata: tailed and tailless Batrachians.

Special relations of members of the fauna to their environment.—Several of the more general relationships between the bromelia-fauna and its environment have been considered under the heading "Environmental conditions of the bromelia-marsh." Some special cases may be briefly mentioned.

Bromelias may be upset by storms and temporarily emptied of their contained water. Many of the fauna can survive temporary desiccation, and some have special means of holding on to the plant. A remarkable case is that of a small Syrphid larva [*] which has ventral suckers; a phenomenon parallel to that seen in the larvæ of another family of flies, the *Blepharoceridæ*, which cling to the rock-faces of waterfalls, &c., by means of suckers.

It appears that some bromelicolous creatures, whose congeners in terrestrial waters swim well, do not swim in the narrow spaces of the "aquarium," but rather climb on the leaves. Reference may be made to one of the longest-known bromelia-dwellers, a Caddis-fly larva found in Brazil by Fritz Müller. This insect, which Müller named *Phylloicus bromeliarum*, con-

[*] Picado, *op. cit.*, pp. 263, 358.

structs a beautiful little case of pieces of leaves. Müller found an allied larva with a similar "house" inhabiting rivulets in the same region. The pupa of the rivulet-dwelling species (which he referred also to the genus *Phylloicus*) agrees with many other trichopterous pupæ in having the middle legs fringed with hairs to form a swimming-organ, which aids it in reaching the surface on its emergence from its cocoon. The pupa of *P. bromeliarum*, however, is devoid of these fringes, which may be correlated with the fact that it probably has no need to swim in order to reach the surface in the narrow spaces of the plant.*

One of the most interesting bromelicolous animals is an Agrionid Dragonfly, *Mecistogaster modestus*, Selys. The insects of this genus are characterized by the extremely exaggerated length and slenderness of the abdomen, which gives them a highly remarkable appearance. Till recently nothing was known of their early stages or breeding-places, but in 1900 it was suggested that they might breed in bromelias. In 1908 specimens were actually bred by Knab from larvæ found in these plants in Mexico, and Calvert in 1909–10 worked out the life-history of the insect in Costa Rica. The abdomen of the larva is not disproportionately long, and the extreme length in the imago is acquired by a very rapid extension during the hours immediately following emergence from the nymph-skin. Thus it may be that the great length of the abdomen in the adult is a secondarily acquired character, and Calvert has suggested that it is possibly an adaptation for ovipositing between the leaves of bromelias in spaces which are too narrow and deep to admit of the female climbing down.†

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* I am indebted to Mr. K. J. Morton for referring me to the literature on this matter. Müller described and figured these larvæ in a paper "Sobre as casas construidas pelas larvas de insectos trichopteros da Provincia de Santa Catharina," Arch. Mus. Nac. Rio Janeiro, iii., 1878. He mentions *P. bromeliarum* on pp. 114, 115, without naming it, and again (in the Supplement) on pp. 131, 132, this time giving it its name; the case of the larva is figured on pl. 9, fig. 17. In the following year (1879) he published a paper in English in the Trans. Ent. Soc. London, and on p. 137 of this volume he refers to the same larva, but without giving it a name. It is also referred to by McLachlan on p. vii. of Proc. Ent. Soc. for that year.

† Calvert, 'Entomological News' (Philadelphia), vol. xxii., 1911, pp. 402–411 and 449–460, pls. xviii.–xix.

Mention must also be made of a new species of Tingitid Bug (*Leptostyla gibbifera*, Picado, *op. cit.*, p. 303), of which great numbers were found in certain bromelias by Picado. These insects feed on the plant, inserting their buccal stylets into its tissues. They remain thus motionless for hours at a time, and it frequently happens that they are caught and held by a gum secreted by the plant, as the result of the wound made by the insect. When thus held fast, one of two fates may attend them: either they may perish, engulfed in the gum; or, if they survive the hot hours of the day, they may be liberated by the melting of the gum at evening, when it receives moisture from the atmospheric condensation. The greater number of those which are thus held gummed to the leaves are immature, and these immature specimens are armed with a number of ramifying spines of rather terrifying appearance (see Picado's figure). As the insects must be absolutely at the mercy of their enemies while thus held fast, these spines might be regarded as a means of defence. But examination shows that each branch of these spines bears at its apex, not a sharp point but a transparent and very delicate vesicle. Unless the vesicles contain some irritant, such fragile structures must be of doubtful protective value.*

Speaking more generally, the creatures normally frequenting bromelias derive their sustenance directly or indirectly from the plants. Some are *phytophagous*, attacking the plant itself: among these are certain Coleoptera, Acari, Hemiptera, some Orthoptera, larvæ of Lepidoptera, &c. Others are *saprophagous*, feeding on *débris*; such are Cockroaches and Earwigs, Millipedes, Pseudoscorpions, and Isopod Crustacea. Others again are *predatory*; among these are *Peripatus*, Scolopendrid Centipedes, Batrachians, Spiders, and many more. Some of the Spiders spin webs above the surface of the water in the compartments of the plant, in such a way as to catch winged insects when they emerge from their aquatic nymphs and take flight; other bromelicolous Spiders chase their prey in the open—such are the numerous Salticids.

Origin and dissemination of the bromelia-fauna.—There are several ways in which species of animals can be supposed not only to have reached the bromelia-marsh in the past but also to reach it still from time to time. Some minute kinds, such as Copepods and Rotifers, could be transported in the form of eggs or cysts by wind. In steep places mud and water, perhaps containing living things, may often be splashed over the boughs of trees by landslides. Many species also have doubtless colonised the plants by active migration. Some would take to frequenting bromelias in order to derive a living from them, either directly or indirectly, in the manners indicated at the close of the preceding section. Others may resort to them in order to escape the evil effects of drought. This may be the case with Snails, Planarians, and Earthworms. In the Seychelles a Land-Nemertean and a Land-Leech were found sometimes in damp places on or near the ground, at other times between *Pandanus* leaf-bases; is not the moisture possibly the attraction of the latter situation? In India, too, certain Oligochæt Worms have been found in hollows half full of water in tree-trunks, whither they resort on the drying up of their habitats on the ground; it is stated that they have been observed in the very act of this migration. As to creatures such as Dragonflies, Caddisflies, &c., it is not hard to imagine that, if they wandered in their flight far into the depths of forests and found there no terrestrial waters, they might lay their eggs in the only available water—that in the reservoir-plants.

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* Picado states that he has also observed the young of another Tingitid similarly gummed to the leaves of *Euphorbiaceæ* of the genus *Croton*.

All this does not explain the origin of *exclusively* bromelicolous species. But is it not conceivable that if some individuals of a species became established in the bromelias, and that if their ranks were not frequently reinforced by the arrival of others of the same species from without; that then they and their descendants might be affected by the isolation in so special a habitat, just as some other forms are affected by becoming restricted in their habits to special food-plants or in other ways? Might not modifications occur, culminating in the forms affected becoming so distinct as to be regarded as separate species? *

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* For a discussion of isolation and segregation of forms due to difference of habits, see the highly suggestive "Introductory Essay on the Hawaiian Fauna," by Dr. R. C. L. Perkins, recently published in 'Fauna Hawaiiensis' (vol. i., part 6, 1913). Perkins lays the greatest stress on *isolation* as a

Several of the above suggested methods of colonisation of the bromelias will also apply to the *dissemination* of the fauna, its passage from plant to plant. But there are also other ways in which it can be *passively* disseminated. For instance, bromelias often grow at different levels on the same tree, and if a plant be upset by any accident its contents may be spilled into others growing below. In such passive ways the fauna need not only descend; it can also slowly ascend. Bromelias reproduce largely by lateral budding, and the young plants grow to a slightly higher level than that of their parents, and in their turn produce buds which push a little higher, and so on. Each lateral bud grows up through one of the interfoliar spaces of the parent plant, and in so doing may carry with it some of the contained water and fauna. Also the boughs and trunks to which the bromelias cling grow slowly upwards and outwards, carrying the epiphytes with them. Thus the *Bromeliaceæ* with their fauna may climb slowly, till they are perched right aloft in the green roof of the forest.

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factor in the production of the great number of endemic species in the Hawaiian Islands. He distinguishes carefully the two kinds of isolation, *viz.* (1) that due to the existence of geographical barriers, and (2) isolation and segregation of forms *inhabiting the same area* due to difference of habits.

NOTES AND QUERIES.

AVES.

Abnormal Coloration in the Common Snipe.—On February 9th Mr. G. Jefferies, of Leadenhall Market, sent for my examination a strange Snipe received in the ordinary way of trade from an English estate. The bird certainly had a most striking appearance, but this was due entirely to the colour of the legs and feet. In plumage, beak, and eyes it was nothing but an ordinary *Gallinago cœlestis*—perhaps a little above the average so far as brightness of colour was concerned; the axillaries held as much white as black in their pattern. The legs and feet were a clear golden or orange buff, flushed here and there on the toes with salmon-pink, and on the "heel" or hinder aspect of the tibio-tarsal joint with pale lemon-yellow; the claws were dark slate-grey. I have many notes on abnormally coloured feet in other birds, but it is the first time I have noticed a Snipe aberrant in this detail.

Exactly a month later Mr. Jefferies sent me a cream-coloured Common Snipe received from Ireland. It was a partial albino deficient in both black and brown pigment, and could be likened in general appearance to a Collared Turtle or the back of the female Sand-Grouse. Such a variety is not very rare, and of itself hardly worthy of record; but I saw at once that the feet and legs were exactly the same yellowish buff as in the first-mentioned individual. There were the same touches of salmon-pink on the toes, and of lemon-yellow on the heel, distinguishable on close examination. In this Journal for 1911* I ventured to suggest that the Common Snipe was one of the most variable of our birds, and the present note may therefore be offered as some addition to my previous remarks.—F. J. Stubbs.

Large Clutch of Great Crested Grebe (Podicipes cristatus) in Glamorgan.—On April 24th I found a nest of the Great Crested Grebe containing the unusual number of six eggs and within a few yards of the spot where, on April 20th, 1912, my friend and I obtained a clutch of nine, as recorded in this Journal (1912, p. 427). A pair of these birds have now visited Hensol for the last four years, and I think it probable that the same pair of birds have laid these two large clutches. On April 18th, on wading out to the nest, I found that it was empty, so that an egg must have been laid daily from that date, and the clutch, although large, may not have been complete. There was no decrease in the size of the eggs last laid, which could be distinguished by being less stained than the others. I have found two Moorhens' nests this year containing fifteen and twelve eggs within sixty yards of each other. By the appearance of the eggs both clutches were laid by a single female.

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* "The Development of the Snipe," pp. 205 and 265.

The Blackcap is much commoner than the Garden-Warbler in this district. The Lesser Whitethroat is rather a scarce bird here, and I have only found it nesting once.—F. NORTON (69, Whitchurch Road, Cardiff).

NOTICES OF NEW BOOKS.

Report on Cetacea Stranded on the British Coasts during 1913. By S. F. HARMER, Sc.D., F.R.S. Printed by Order of the Trustees of the British Museum.

THIS Report and others that will subsequently appear must prove to be of the greatest importance to British zoology. The Board of Trade in 1912 decided to issue a circular to all Receivers of Wrecks instructing them to send telegraphic information to the British Museum of the stranding of Whales. The records of 1913, thus procured, with the exception of three obtained during 1911 and 1912, form the substance of this Report.

The number of Whales, Dolphins, &c., reported during 1913 was seventy-six, though the number given cannot be regarded as completely accurate, because evidence has been forthcoming that some of the specimens originally reported as "Porpoises" have really been Sharks. A definite determination of the species has been found possible in only a small proportion of the cases. This has generally been based on the examination of the entire animal or some part of it, which has been forwarded to the Museum. In a few instances a representative of the Museum has visited the spot where the specimen was stranded, and the evidence thus obtained has been the authority for the determination.

Calculations made by "curve" process show a sudden rise from two specimens in July to fifteen in August, while the maximum was reached by twenty-one in the first half of October. A conclusion is considered legitimate that a larger number of Cetacea, which have not been captured by fishing-boats, are stranded during August, September, and the first half of October than at other times of the year. It also seems that, although the case is not certainly made out by figures, there may be some connection between the stranding of the Cetacea and the position of the Herring fishery at the time. Reference to the species obtained is given in this excellent Report, and three distributional maps are provided. This publication is worthy of the high standard of our great Natural History Museum.

Animal Life by the Sea-shore. By G. A. and C. L. Boulenger. 'Country Life' Limited.

We have to recall early days—some fifty years ago—for books on our seaside zoology. Our shelves still contain 'Seaside Studies,' by George Henry Lewes; Charles Kingsley's 'Glaucus, or the Wonders of the Shore'; 'The Sea-Side Book' of Dr. Harvey; and the delightful writings of Philip Henry Gosse. Then somewhat of a hiatus ensues, Step published his 'By the Deep Sea' in the late nineties; but the time had arrived for a more modern guide, and the Boulengers have produced it. "A strictly systematic treatment has been avoided, the classification adopted being intended to meet the requirements of the non-scientific reader, who is introduced to the subject in the simplest manner compatible with accuracy."

Seaside visitors who are wearied with the band on the pier, the comic efforts of minstrels on the beach, or a melancholy contemplation from a beach-chair, will find in the pages of this book an animal romance which they can unravel for themselves.

Natural history lovers and students will possess a safe guide in these authoritatively written and well-illustrated pages, and by their help return from a summer holiday neither wearied nor jaded, but rejuvenated by a healthy recreation and intelligent pursuit. We recommend this volume as a seaside companion for a summer holiday, while it will be appreciated by any naturalist. Such books have a zoological mission among the general public apart from their value to naturalists.

Wild Game in Zambezia. By R. C. F. MAUGHAM, F.R.G.S., F.Z.S., &c. John Murray.

THE contents of this well-illustrated volume constitute a happy blend of the experiences of a sportsman and naturalist, and it is with the latter we are most concerned, for Mr. Maugham has much to tell us of the splendid but now attenuated vertebrate fauna of the African plains. He can also think for himself. Thus the peculiar coloration and markings of Zebras, which against a background of thin forest or high grass makes them easily overlooked—as was observed by the late Francis Galton years ago—has been accepted by many as a typical example of protective coloration. But before man commenced his destructive work these animals knew but one enemy, the great carnivora. "These hunting as they do by night and by scent, could not, as it seems to me, have been regarded as the dreaded source of danger. One therefore asks oneself in vain what the reason for a protective colour scheme for use *by day only* could possibly have been?"

In reference to the suggested game extermination in order to decrease the number of Tsetse Flies, which seem to spread with the game and increase in numbers as the herds increase, Mr. Maugham writes of vast tracts of "fly country" from which game is absent, and in some cases have been absent during the recollection of natives. The writer on African mammals cannot afford to miss a careful perusal of this book, though in some cases a little caution must be used. Thus we read, "Secretary-birds pursue their benevolent mission in the slaughter of the Snakes"; but probably the author is quite aware that the Snake is not by a very long way the principal food of this bird.

Many will rejoice to read in the introduction the sympathetic recognition of the "Camera Sportsman." He quotes with approval the view of Mr. Dugmore, "The life of any animal, be it bird or beast, is far more interesting than its dead body." True words, and the writer of this notice wishes he had always followed that maxim.

A List of the Birds of Australia. By GREGORY M. MATHEWS, F.R.S.E., &c. Witherby & Co.

A COMPLETE list to date of the birds of Australia, "containing the names and synonyms connected with each genus, species, and subspecies" will be valued by all ornithologists. Mr. Mathews has given his adhesion to what may be called the newer nomenclature, including the use of trinomials, and there can be little doubt that this advanced method has come to stay, though it may seem somewhat foreign to many of us who have been schooled in another method. The whole question is fully discussed in the Introduction.

As regards the vast stride made in a knowledge of the avifauna of Australia, we are struck with the statement that "no endemic land bird from Australia was known to Linné when he published his 'Systema Naturæ' in 1758 and 1766"; and in recognizing the early writings of Latham, most naturalists will agree with Mr. Mathews in his conclusion that "there can be no question as to who should be considered the 'grandfather' of Australian ornithology, conceding to John Gould the Australians' tribute of 'father.'"

The list has been very carefully and thoroughly compiled, and possesses an excellent index.

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